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Scintillation Imaging with Coded Aperture Masks

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Most noble liquid detectors employ scintillation light as either a timing signal for a TPC or as a calorimetric measurement, or both. Its relative amplitude and timing on multiple detectors can also be used to approximately locate an interaction.
Scintillation imaging goes a step further, introducing an optical system in front of finely segmented SiPM matrices. The objective is to build photographic cameras that capture images of the primary scintillation light.
In absence of a TPC, scintillation imaging alone can provide vertexing and tracking information, while combined it can enhance resolution and rate capability (which is a concern for near detectors located on powerful neutrino beams).
Both Xe and Ar scintillate in the VUV range, imposing stringent requirements on the optical system and SiPMs. Instead of using a set of lenses, a thin and compact camera with both deep and wide field of view can be created by using a coded aperture mask. This technique, already in use for X-ray and gamma photons, provides a reliable method of image formation at the cost of complex offline processing. The coded mask itself can further be made charge sensitive in order to obtain a combined charge and light detector.

The latest results from simulation and reconstruction of neutrino interactions in a LAr detector equipped with coded aperture cameras will be presented. A review of the applications, such as in DUNE/SAND, and the development status of key enabling technologies will also be included.

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